UCRL-JC-126565 Abs

Title: Use of Giant Magnetoresistive Devices for Magnetic Field Sensing Applications

Author: Alison Chaiken
Materials Science and Technology Division
Lawrence Livermore National Lab
(510) 422-7129
(510) 422-6892 (FAX)
chaiken@llnl.gov

The discovery of the giant magnetoresistance (GMR) effect in France in 1988 has led to the development of a new generation of integrated-circuit magnetic sensors. Giant magnetoresistors are considerably more sensitive than previously available room-temperature-operation solid-state magnetometers, yet they are relatively simple to manufacture. The theoretical sensitivity limit of giant magnetoresistors is less than 1 nanoTesla, comparable to the performance of superconducting quantum interference device (SQUID) magnetometers, but without the need for cryogenic cooling. GMR sensors have been commercially available for only a few years and have not yet achieved their ultimate level of performance, although they are improving rapidly. Magnetoresistive sensors are increasingly replacing inductive coil sensors in disk drive read heads. A significant advantage of GMR in this application is that the magnetoresistive signal is independent of the frequency of the excitation field, unlike the inductive signal from a pickup coil.

In this talk the underlying physical basis of the giant magnetoresistance effect will be presented. The performance characteristics of GMR sensors will be compared to those of other magnetic field measurement technologies like Hall-effect devices, SQUIDs, magnetotransistors, fluxgate devices and permalloy film sensors. The mode of operation of GMR devices will be described. Some industrial and military applications of giant magnetoresistors will be presented in detail. Part of this work was performed under the auspices of the U.S. Department of Energy (DOE) by LLNL under contract number W-7405-ENG-48.